# ANALYSIS OF PALM OIL WASTE AFTER PRETREATMENT USING ENVIRONMENTAL RECYCLING SYSTEM (ERS) FOR THE POTENTIAL APPLICATION AS ANIMAL FEED

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by

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## DECLARATION BY AUTHOR

This dissertation is composed of my original work, and contains no material previously published of written by another person except where due reference has been made in the text. The content of my dissertation is the result of work I have carried out since the commencement of my research project and does not include a substantial part or work that has been submitted to qualify for the award of any other degree or diploma in any university or other tertiary institution.

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## LIST OF SYMBOLS AND ABBREVIATIONS~

| Symbol | Caption |
|---|---|
| % | Percentage |
| ± | Plus Minus |
| ≤ | Less Than or Equal To |
| = | Equivalent |
| ℃ | Degree Celcius |
| ~ | Tilde |
| : | Colon |

| Abbreviation | Caption |
|---|---|
| POME | Palm Oil Mill Effluent |
| GHG | Greenhouse Gases |
| HRT | Hydraulic Retention Time |
| ERS | Environmental Recycling System |
| XRF | X-ray Fluorescence |
| MPOB | Malaysia Palm Oil Board |
| COD | Chemical Oxygen Demand |
| BOD | Biochemical Oxygen Demand |
| DMD | Dry Matter Digestibility |
| PHAs | Polyhydroxyalkanoates |
| HHV | High Heating Value |
| G | Gram |

| | |
|---|---|
| Mm | Millimeter |
| mL | Milliliter |
| Kg | Kilogram |
| Mg | Milligram |
| UOP | United Oil Palm |
| MC | Moisture Content |
| HPLC | High Performance Liquid Chromatography |
| Sp | Species |
| ANOVA | Analysis of Variance |
| UASFF | Up-flow Anaerobic Sludge Fixed Film |
| Si | Silica |
| K | Potassium |
| Ca | Calcium |
| FAD | Fatty Acid Distillate |

# ANALISIS SISA KELAPA SAWIT SELEPAS PRA-RAWATAN MENGGUNAKAN SISTEM KITARAN SEMULA ALAM SEKITAR (ERS) UNTUK APLIKASI SEBAGAI MAKANAN HAIWAN

## ABSTRAK

Kesan persekitaran dari sisa efluen kilang kelapa sawit (POME) telah menjadi perhatian kerana pencemaran air dan pelepasan gas rumah hijau (GRK). POME biasanya dilepaskan ke kolam terbuka untuk pemulihan, yang memerlukan masa pengekalan hidraulik (HRT) yang lebih lama dan mengakibatkan pelepasan GRK. Selain itu, EFB telah dihasilkan dalam kuantiti yang banyak dan masih belum digunakan secara khusus dan dibuang dengan kaedah pembakaran. Oleh itu, kajian ini dilakukan untuk merawat POME dan EFB melalui Sistem Kitaran Semula Alam Sekitar (ERS) untuk mengubah sisa ini menjadi produk bernilai seperti makanan haiwan. ERS adalah kaedah inovatif baru untuk mengurangkan sisa POME dan EFB. Terdapat empat nisbah POME: EFB yang dikaji termasuk 3: 7, 5: 5, 7: 3, dan 20: 1. Setelah rawatan ERS, semua nisbah sampel dibentuk menjadi pelet dengan diameter 6 – 8 mm. Sampel sebelum dan selepas rawatan ERS dianalisis dan dibandingkan dengan makanan haiwan yang tersedia secara komersial. Analisis menunjukkan bahawa sampel adalah sumber makanan yang kaya dengan tenaga kerana mempunyai kandungan lemak yang tinggi. Sampel dengan nisbah 3:7 menunjukkan peratusan abu yang rendah (10.946 ± 0.289 %) serta peratusan yang tinggi kandungan lemak (6.531 ± 1.018 %) dan protein (3.656 ± 0.265 %) yang lebih sesuai untuk dijadikan makanan haiwan ruminan seperti lembu dan kambing. Seterusnya, penambahan suplemen lain seperti kacang soya juga diperlukan bagi meningkatkan jumlah protein didalam sampel. Selain itu, analisis HPLC menunjukkan bahawa komposisi gula yang terdapat dalam sampel adalah glukosa, fruktosa dan sukrosa. POME menunjukkan kepekatan glukosa tertinggi selepas rawatan ERS. Di samping itu, analisis elemen dilakukan dengan menggunakan kaedah XRF. Mineral tertinggi yang terdapat dalam POME adalah kalium diikuti oleh klorin, sementara zat besi hanya dikesan di EFB selepas rawatan ERS. Secara keseluruhan, POME dan EFB adalah sumber makanan alternatif yang baik untuk mengembangkan potensi makanan haiwan.

**ANALYSIS OF PALM OIL WASTE AFTER PRE-TREATMENT USING ENVIRONMENTAL RECYCLING SYSTEM (ERS) FOR THE APPLICATION AS ANIMAL FEED**


## ABSTRACT

The environmental impacts of palm oil mill effluent (POME) have been a concern due to the water pollution and greenhouse gases (GHG) emission. POME is usually released into open-air ponds for remediation, which required longer hydraulic retention time (HRT) and resulting in GHG emissions. Moreover, the abundant of empty fruit bunch (EFB) has been produced and yet has no specific used in large quantity and disposed by incineration method. Thus, this study was conducted to simultaneously treat POME and EFB via Environmental Recycling System (ERS) to convert into value-added product such as animal feed. ERS is an novel innovative method in order to minimize the POME and EFB waste. There are four ratios of POME:EFB is being studied including 3:7, 5:5, 7:3, and 20:1. Upon ERS treatment, all samples ratio is formed into pellet with diameter of 6-8 mm. The samples, before and after the ERS treatment were analysed and compared with commercially available animal feed. Proximate analysis indicated that samples are energy rich source of food due to high content of fats. The sample with ratio 3:7 shows the low percentage of ash (10.946 ± 0.289 %) and high percentage of crude fat (6.531 ± 1.018 %) and protein (3.656 ± 0.265 %) content which is preferable for ruminant animal feeds such as cow and goat. Moreover, the, addition of other supplement such as inclusion of soybean also necessary in order to boost protein amount in sample. In other hands, HPLC analysis showed that the composition of sugar present in the samples are predominantly glucose, fructose and sucrose. POME showed highest concentration of glucose after ERS treatment. In addition, elemental analysis was performed by using XRF method. The highest minerals present in POME is potassium followed by chlorine, and trace amount of iron is detected only in EFB after ERS treatment. Overall, POME and EFB can be considered as a good source to develop potential animal feed.